

The SMS Steering Module Coupling ADCIRC and STWAVE

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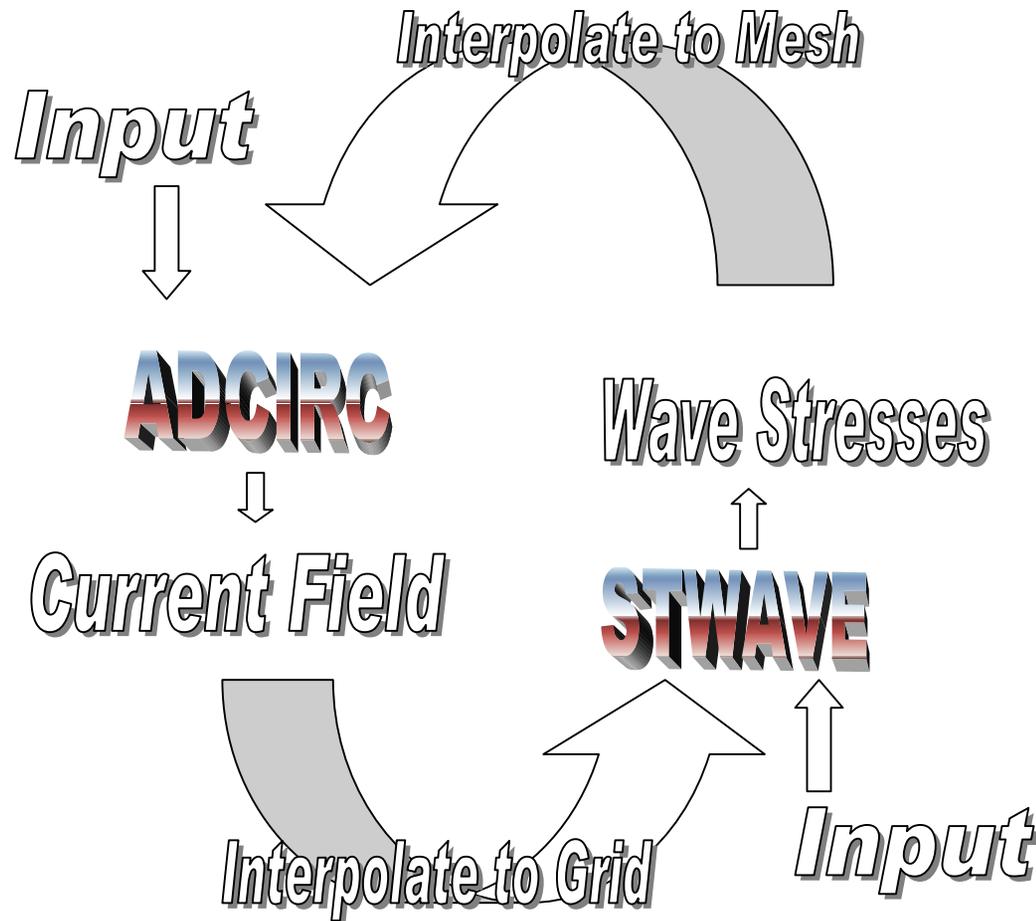
Steering Module Objectives



- Simplify data sharing between models
- Monitor model runs
- Save time by automating repetitive user tasks
- Achieve more accurate results from models



ADCIRC ↔ STWAVE



- Challenges:
 - Steady state vs. transient
 - Domain Size
 - ADCIRC: large mesh
 - STWAVE: small grid
 - Output organization

ADCIRC-STWAVE Coupling



ADCIRC

- ◆ Finite element numerical model
- ◆ Time dependent
- ◆ Large area application
- ◆ Computes nodal elevations and velocities
- ◆ Optional wave stress input

STWAVE

- ◆ Finite difference numerical model
- ◆ Steady State
- ◆ Small area application
- ◆ Computes wave stress, magnitude and direction
- ◆ Optional current input



ADCIRC-STWAVE Coupling



- Input/Output Sharing
 - STWAVE gets current data from ADCIRC
 - ADCIRC input from STWAVE wave radiation stress output
- Potential coupling issues:
 - Steady state vs. transient
 - Domain Size
 - ADCIRC: large mesh
 - STWAVE: small grid



Conventional Method

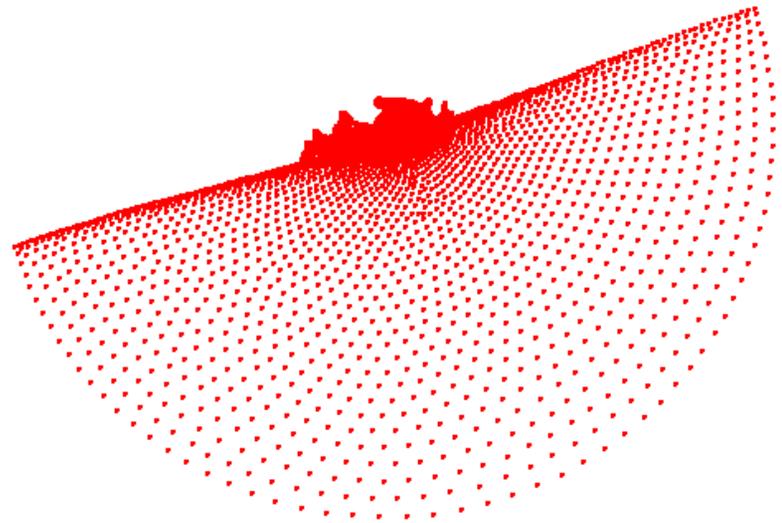
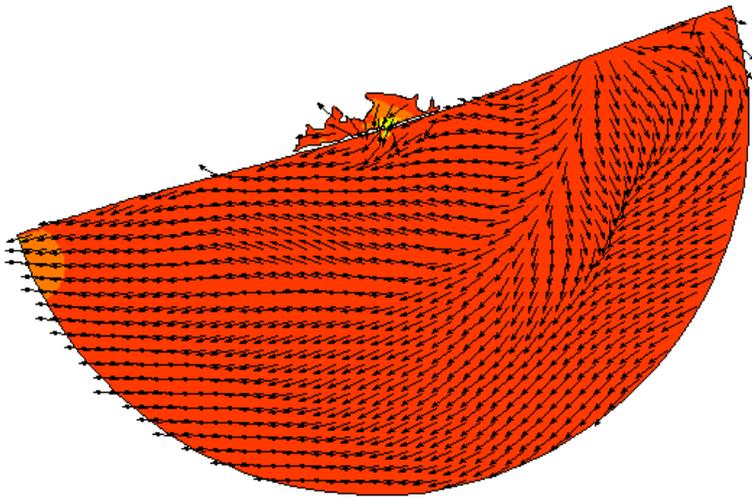


1. ADCIRC mesh and STWAVE grid generation
2. Specify model run parameters
3. Save simulation and run ADCIRC
4. Read solutions and interpolate data to grid
5. Save simulation and run STWAVE
6. Read solutions and extrapolate data to mesh
7. Update model run parameters
8. Repeat Steps 3-7



Currents

ADCIRC Current Solution -> Scatter



Automated Steering Method

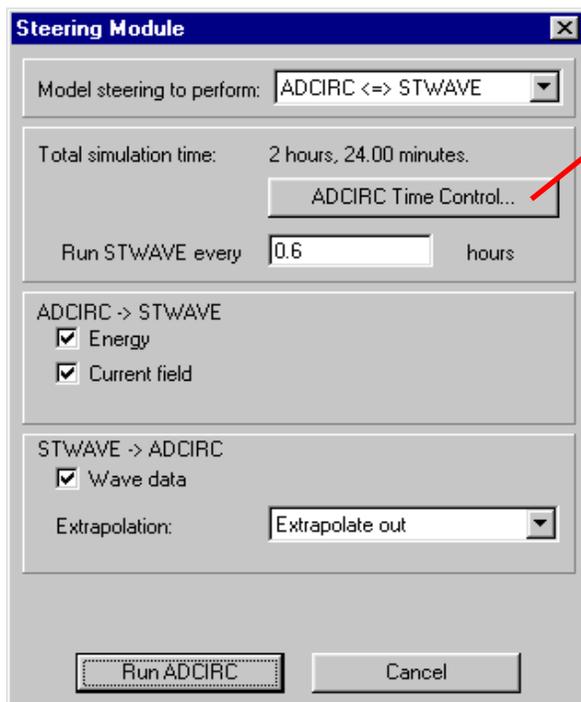


1. ADCIRC mesh and STWAVE grid generation
2. Specify model run parameters
3. Specify steering parameters
4. Launch steering



Steering Process

- Specify:
 - Simulation times
 - Run frequency



Steering Module

Model steering to perform: ADCIRC \Leftrightarrow STWAVE

Total simulation time: 2 hours, 24.00 minutes.
ADCIRC Time Control...

Run STWAVE every 0.6 hours

ADCIRC -> STWAVE

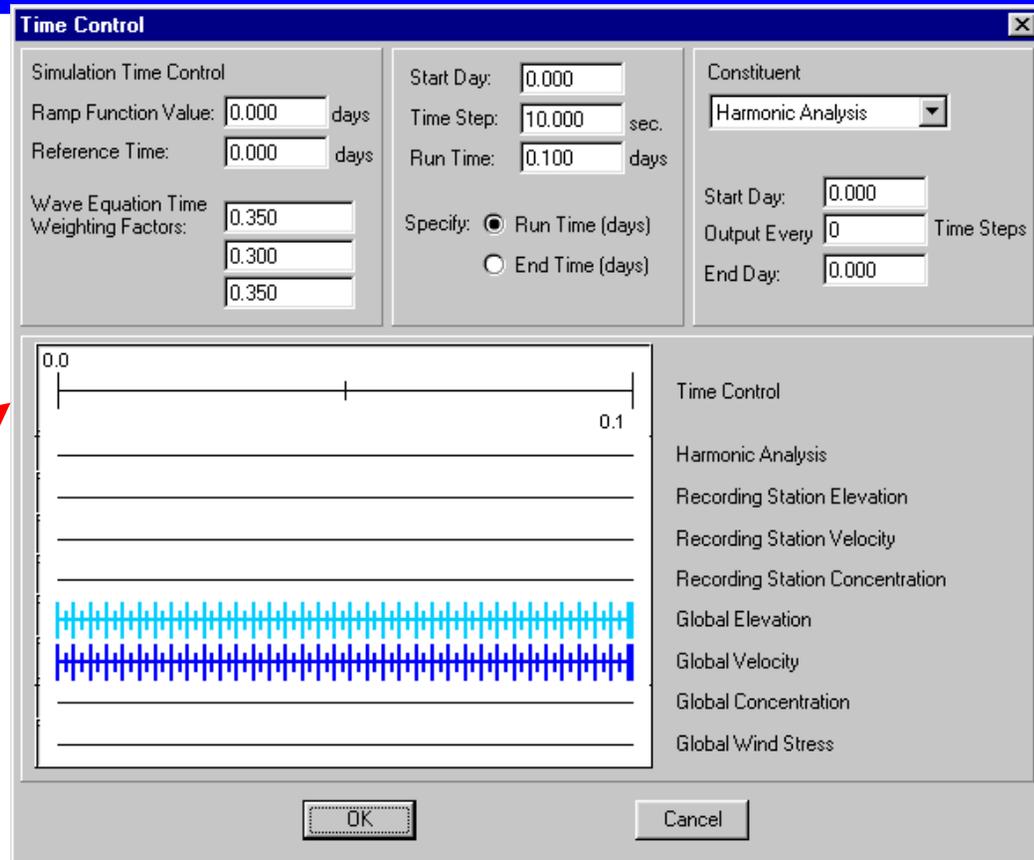
- Energy
- Current field

STWAVE -> ADCIRC

- Wave data

Extrapolation: Extrapolate out

Run ADCIRC Cancel



Time Control

Simulation Time Control

Ramp Function Value: 0.000 days
Reference Time: 0.000 days

Wave Equation Time Weighting Factors: 0.350, 0.300, 0.350

Start Day: 0.000
Time Step: 10.000 sec.
Run Time: 0.100 days

Specify: Run Time (days)
 End Time (days)

Constituent: Harmonic Analysis

Start Day: 0.000
Output Every 0 Time Steps
End Day: 0.000

Time Control

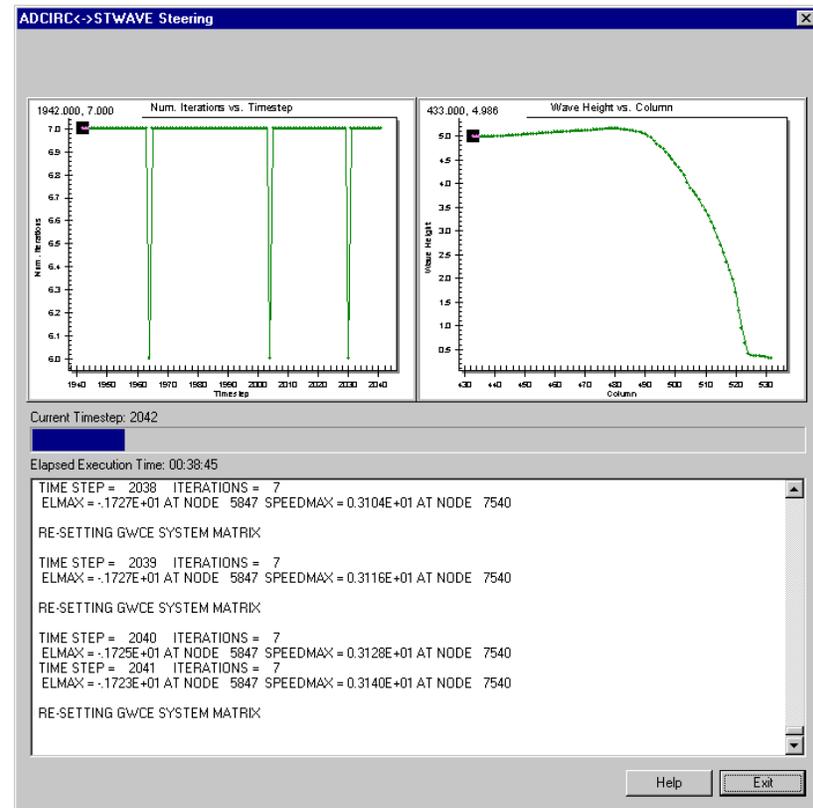
- Harmonic Analysis
- Recording Station Elevation
- Recording Station Velocity
- Recording Station Concentration
- Global Elevation
- Global Velocity
- Global Concentration
- Global Wind Stress

OK Cancel

Steering Module Process



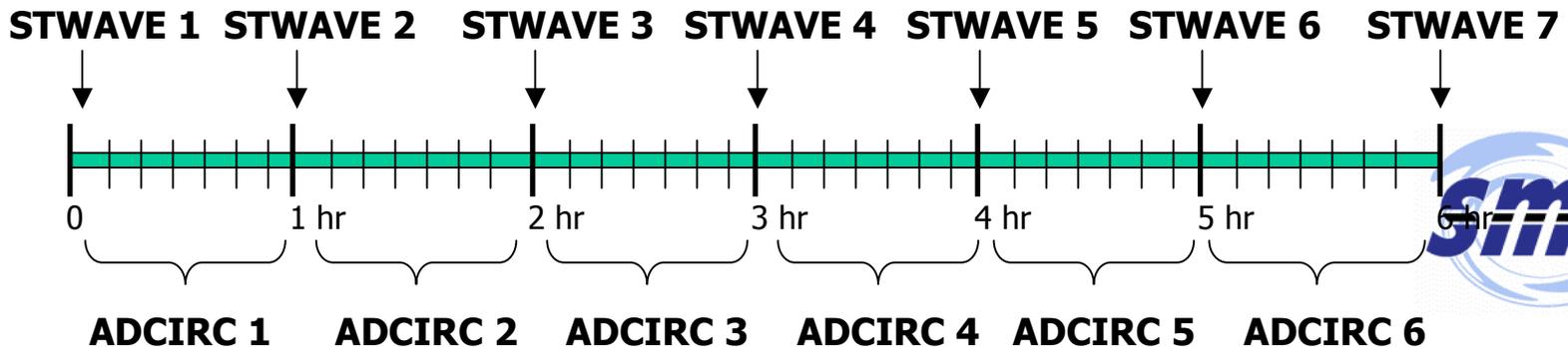
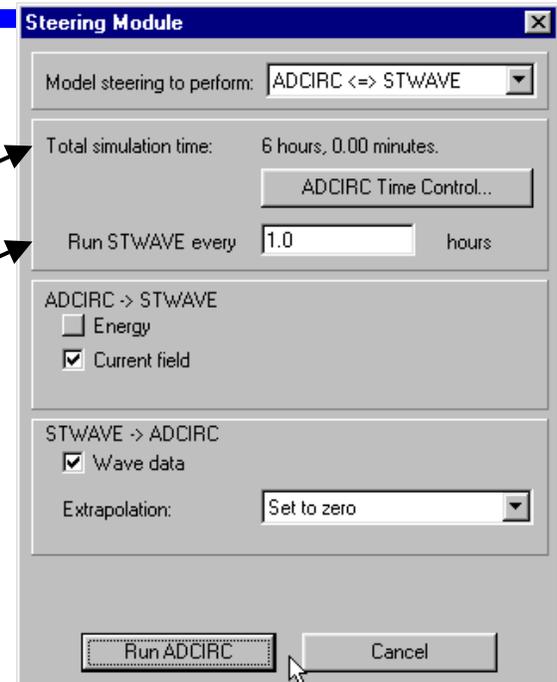
- Automated Process:
 - Launches numeric model
 - Monitors model completion
 - Data interpolation
 - Saves necessary files
 - Repeat



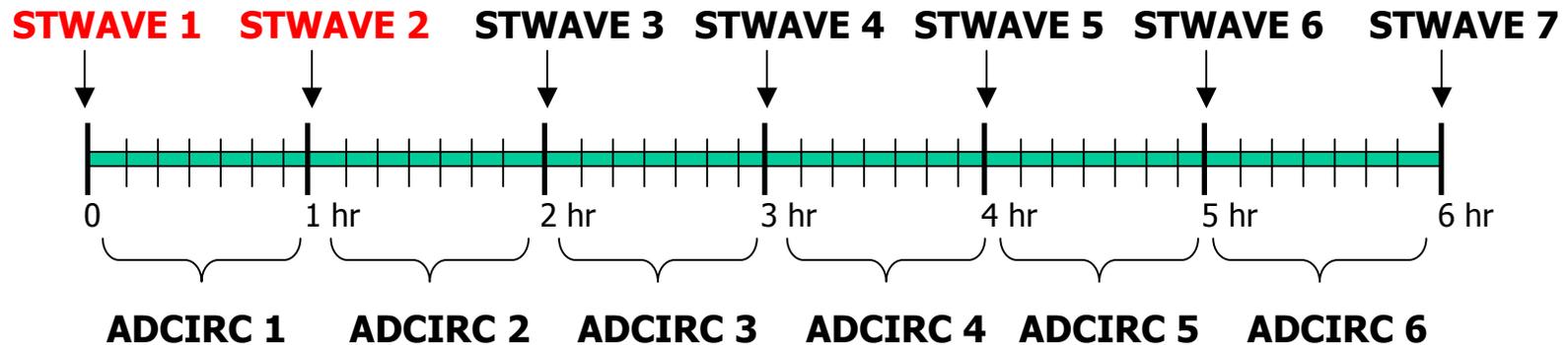
Steering Module Timeline



- Example:
 - Total ADCIRC simulation time: 6 hrs
 - Time step: 1 minute (60 time steps per steering step)
 - Run STWAVE every 1 hr

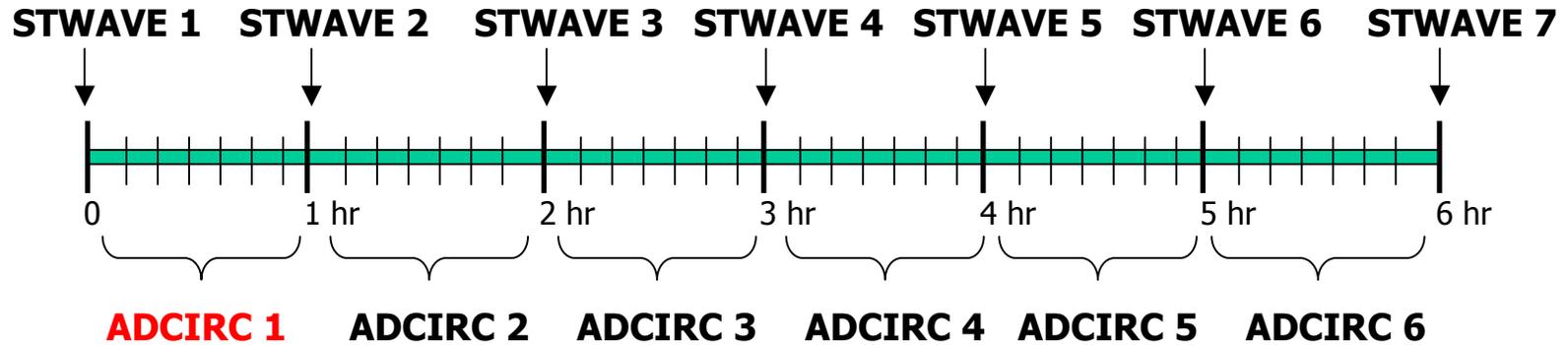


Steering STWAVE



- Read ADCIRC velocity solution (except for STWAVE 1)
- Interpolate values to STWAVE grid
- Save STWAVE simulation
- Launch STWAVE

Steering ADCIRC



- Read STWAVE radiation stress solutions
- Interpolate values to ADCIRC mesh
- Create Unit 23 input file for ADCIRC – Save new Simulation
- Launch ADCIRC
 - Writes Success/Error in status
 - Solution appended to file

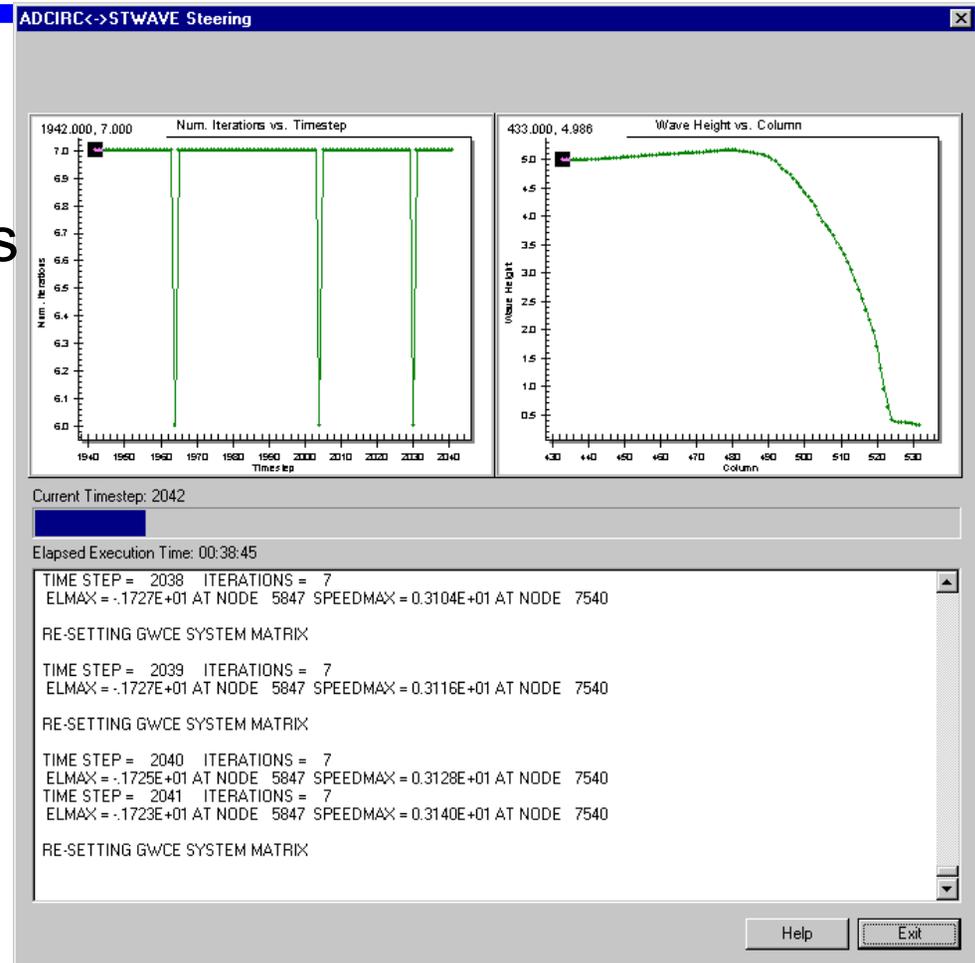


Model Wrapper



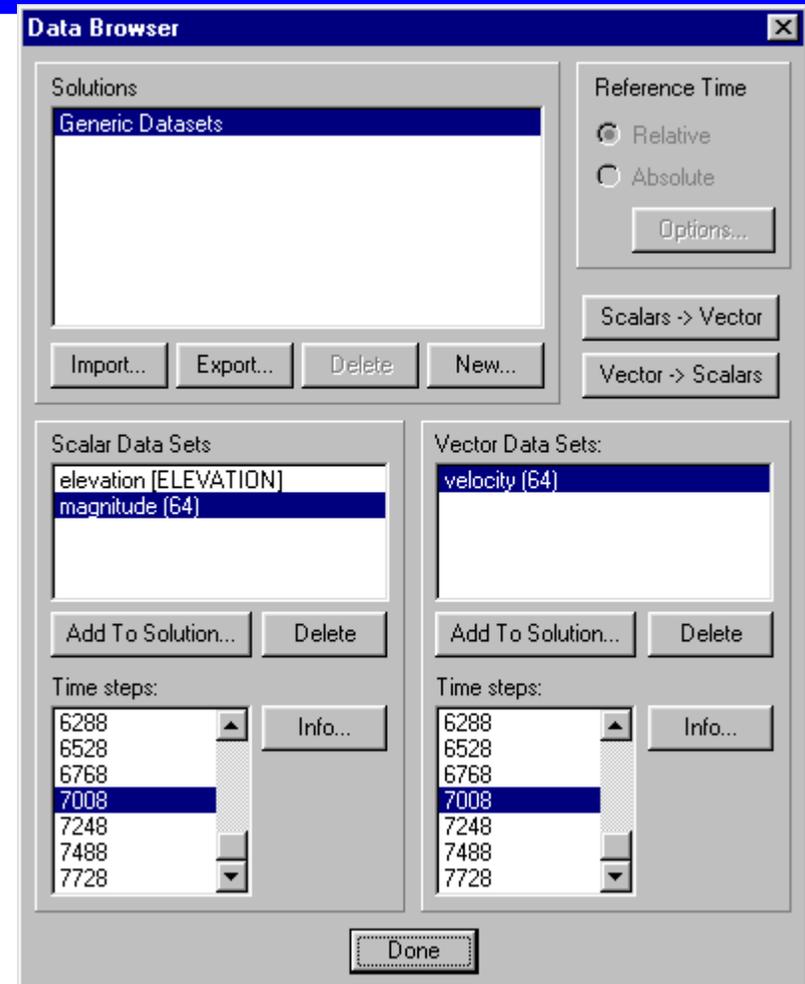
Features:

- Custom real-time plots
- Elapsed time
- Progress bar
- Better CPU management

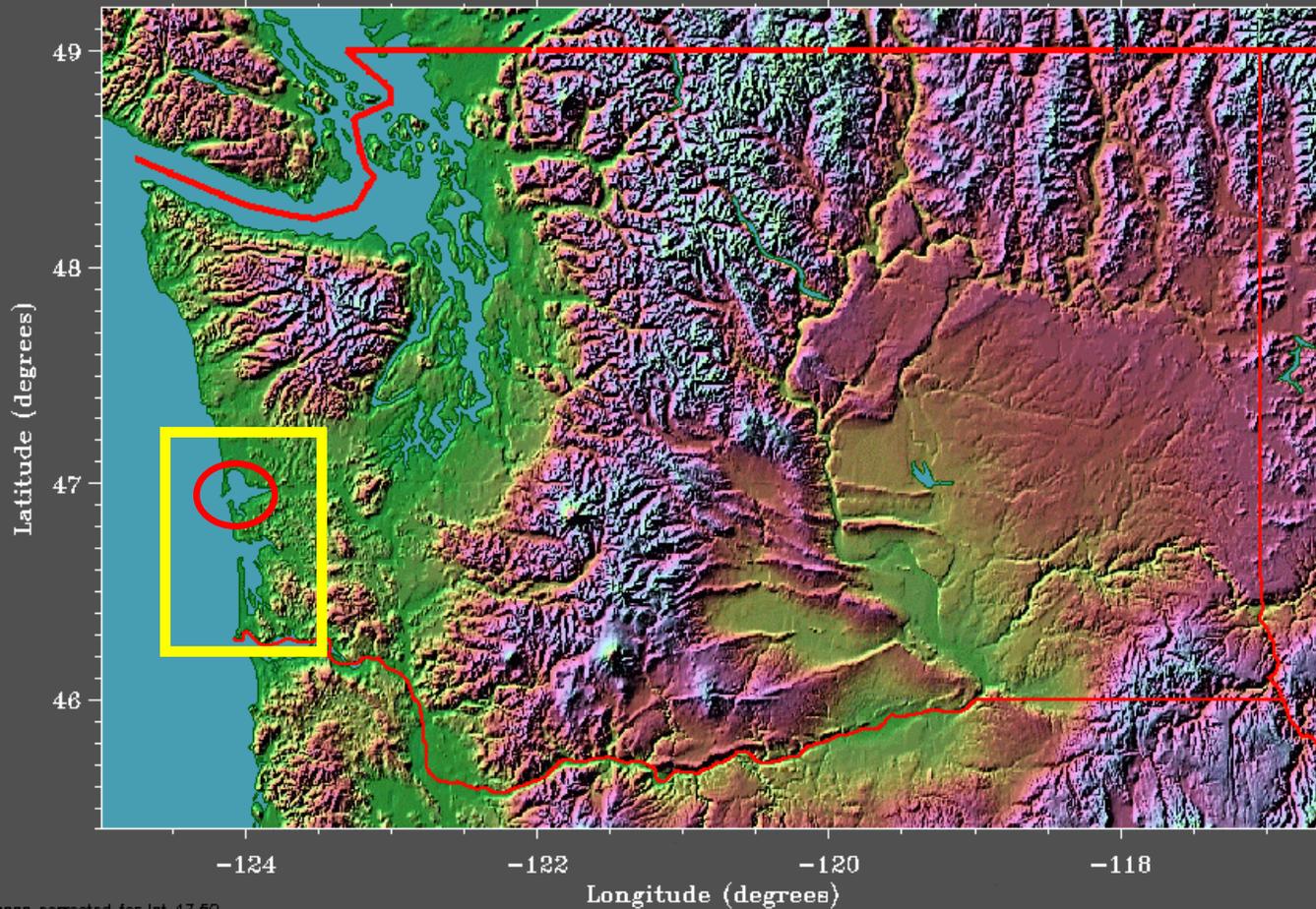


Viewing Results

- Import into SMS using Data Browser/File Open
- Scalar contours
- Vector arrows
- Film Loops



Grays Harbor Case Study



Shape corrected for lat 47.50

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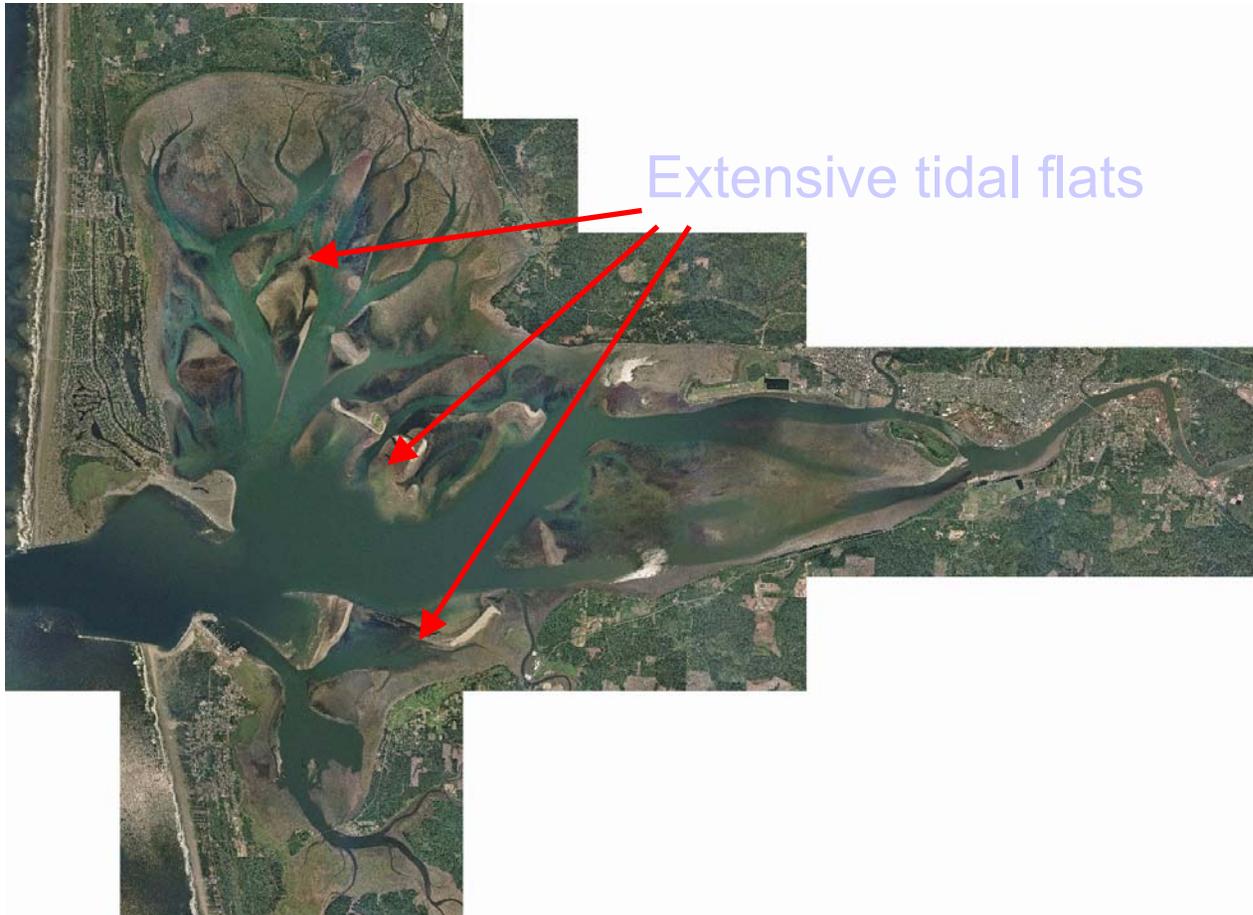
Grays Harbor Case Study



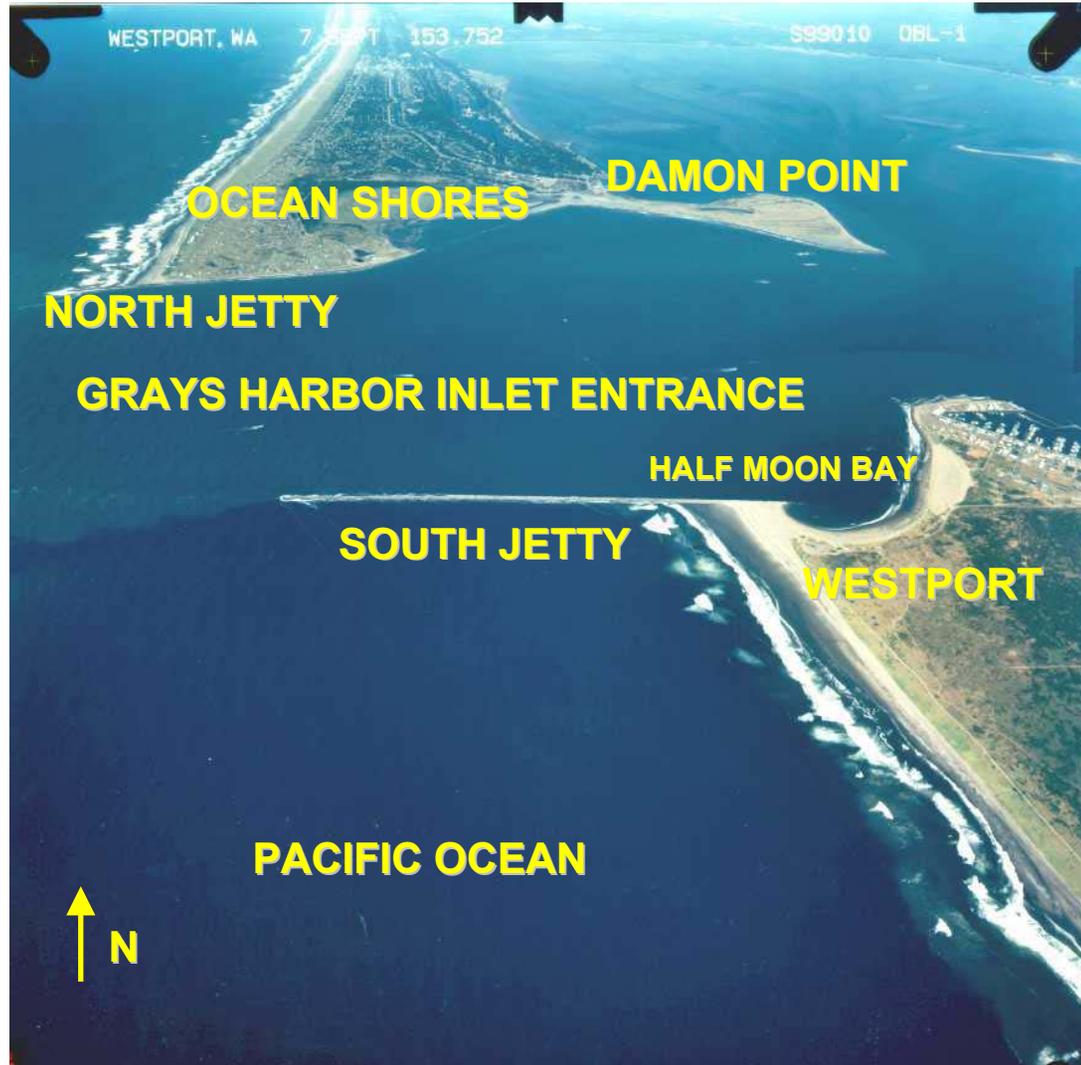
- Physical Environment
- Engineering Motivation
- Coupling Effects on Model Results



Physical Environment



Physical Environment



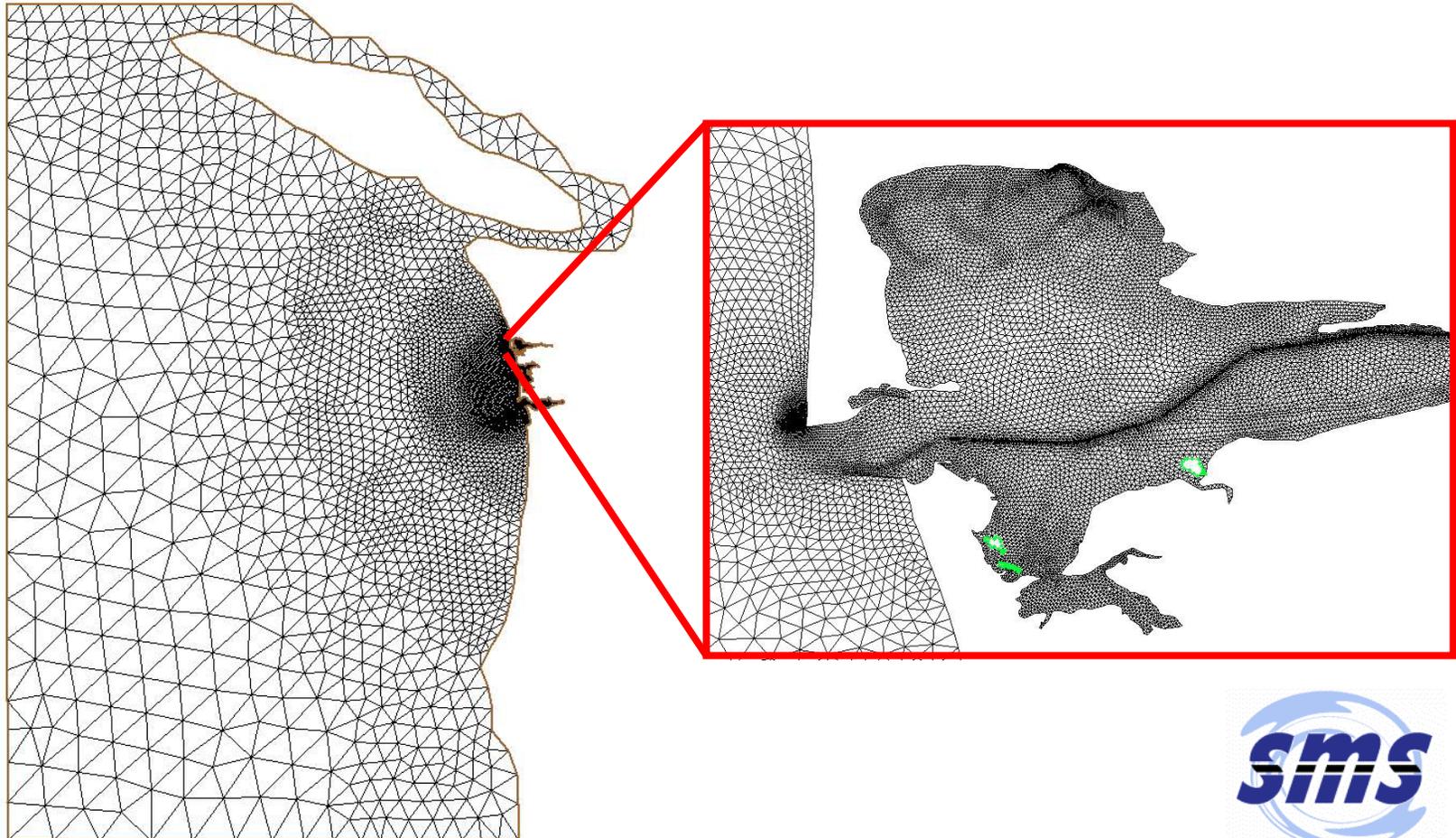
Engineering Motivation



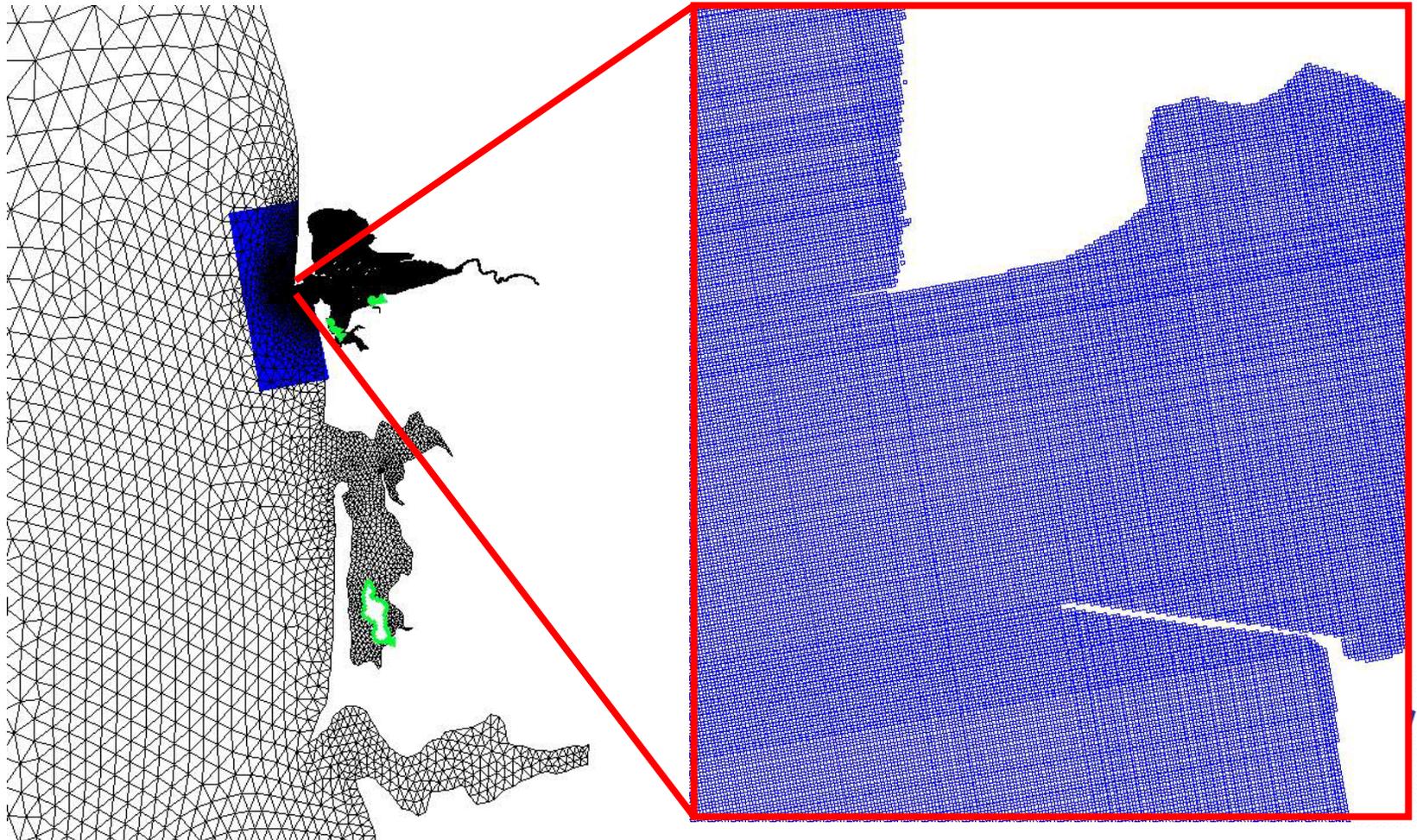
Channel Realignment:



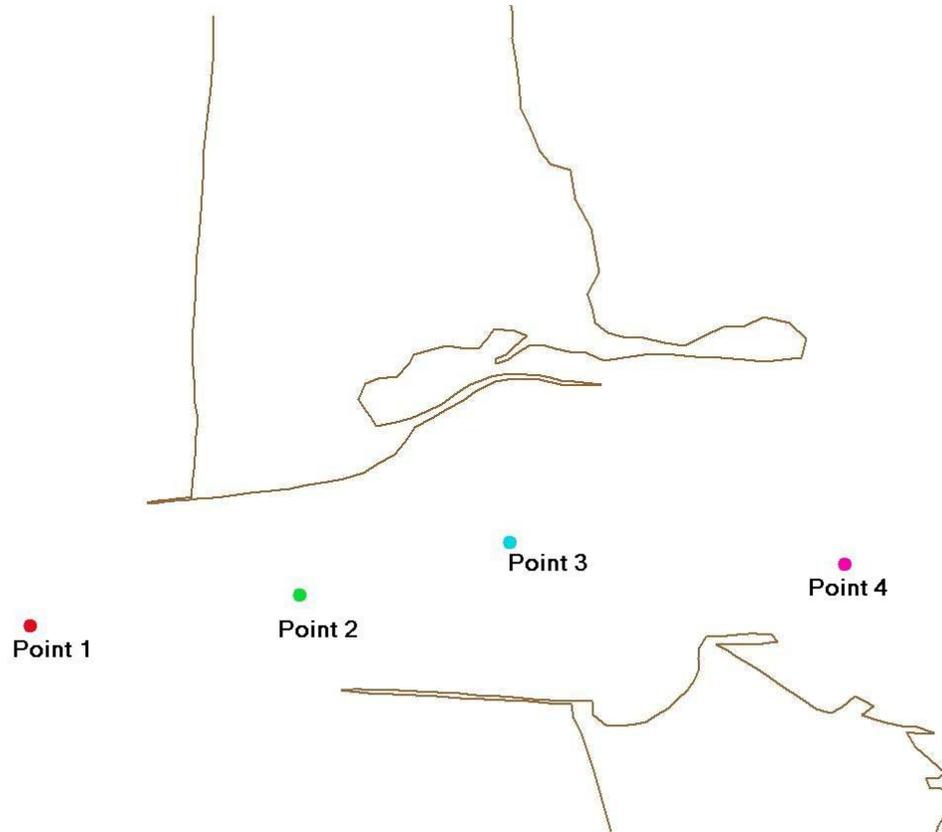
ADCIRC Mesh



STWAVE Grid



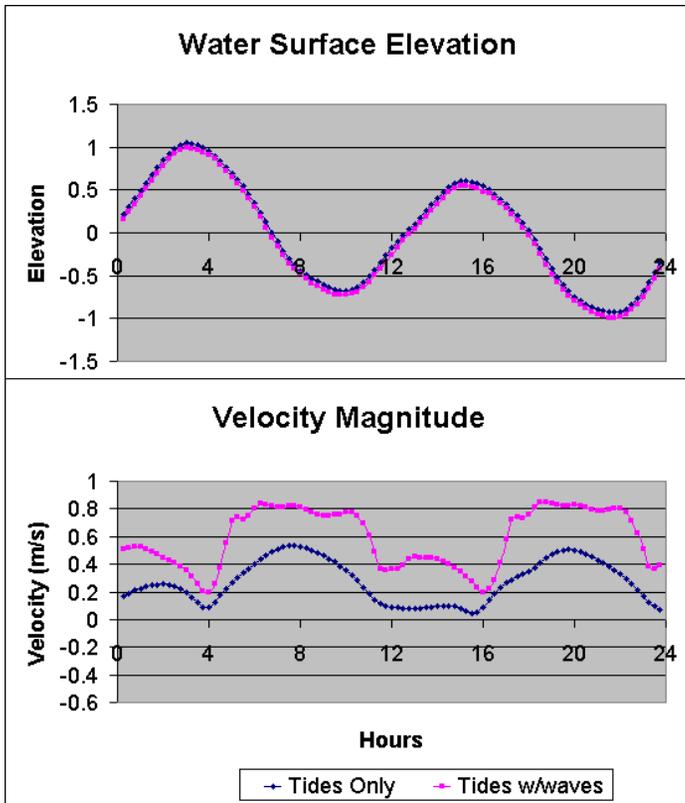
Case Study Results



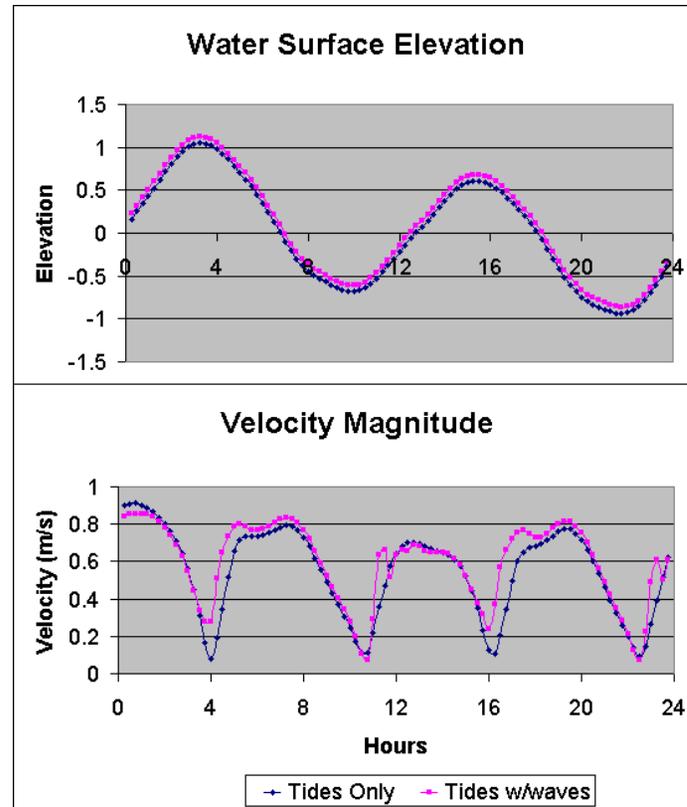
Location of Observation Points



Case Study Results

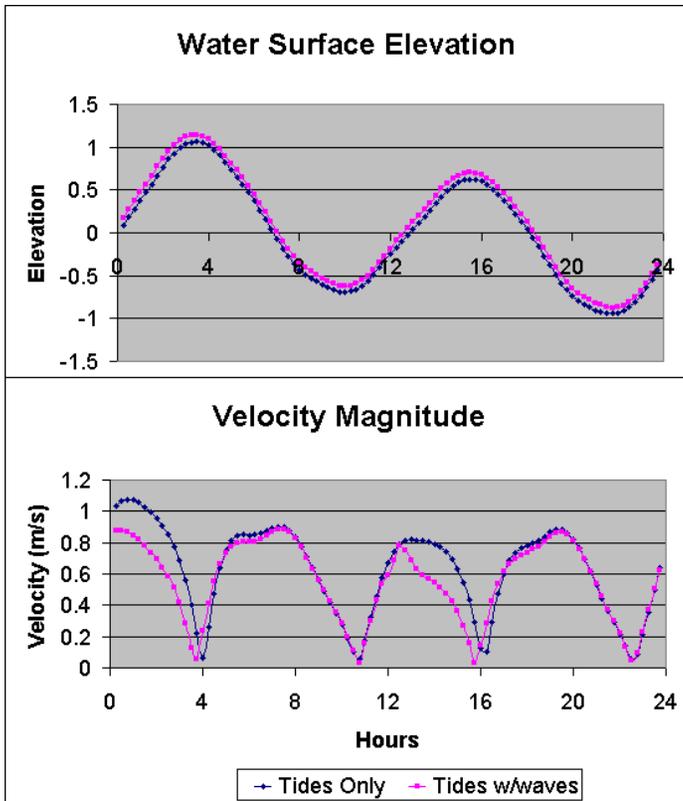


Point 1 outside of inlet

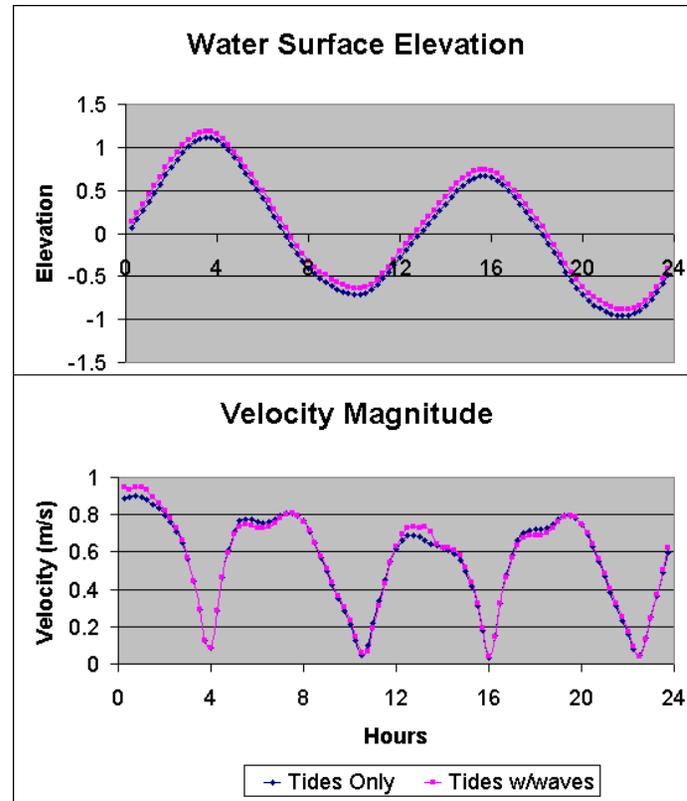


Point 2 inside mouth of inlet

Case Study Results

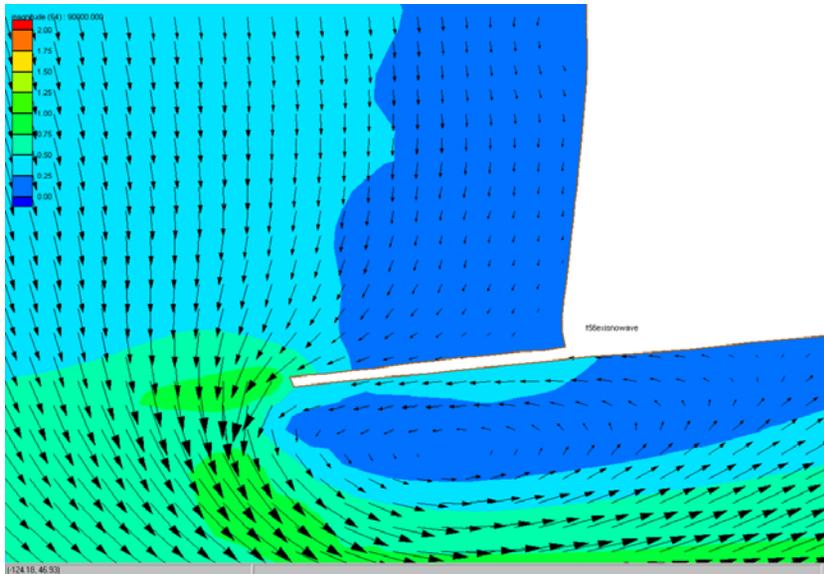


Point 3 inside mouth of inlet



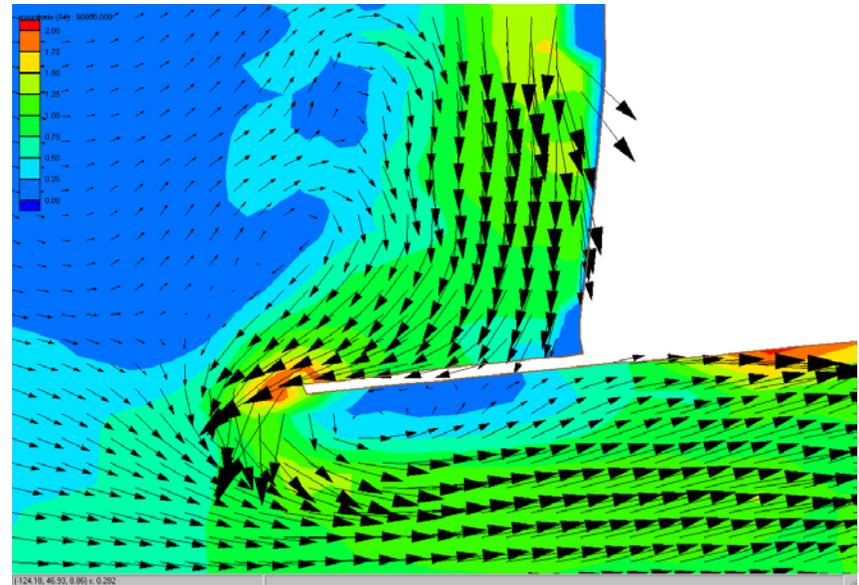
Point 4 inside harbor

Currents

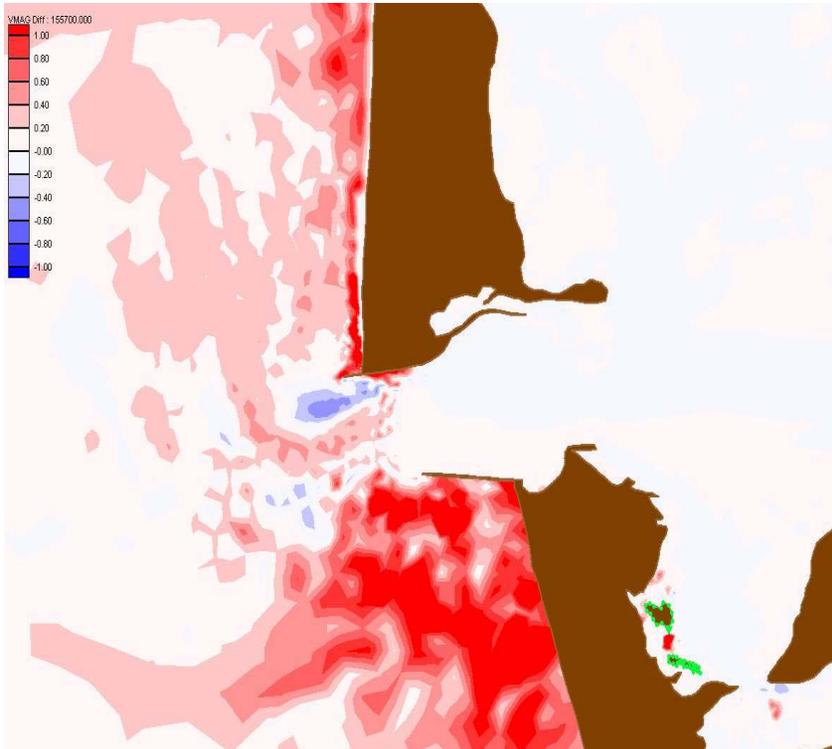


Tide Only

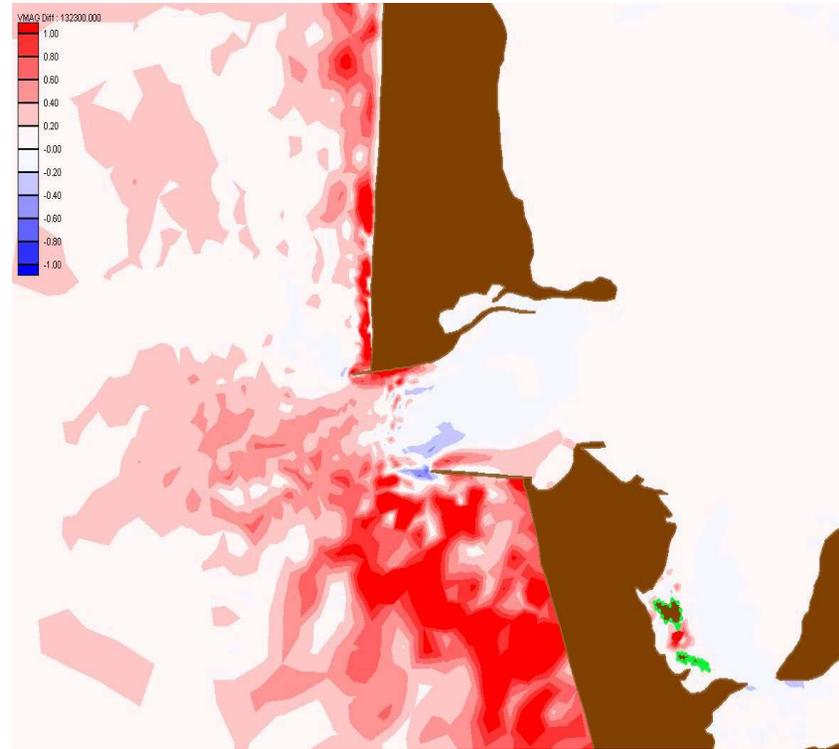
Tide with Waves



Velocity Magnitude



Peak Ebb



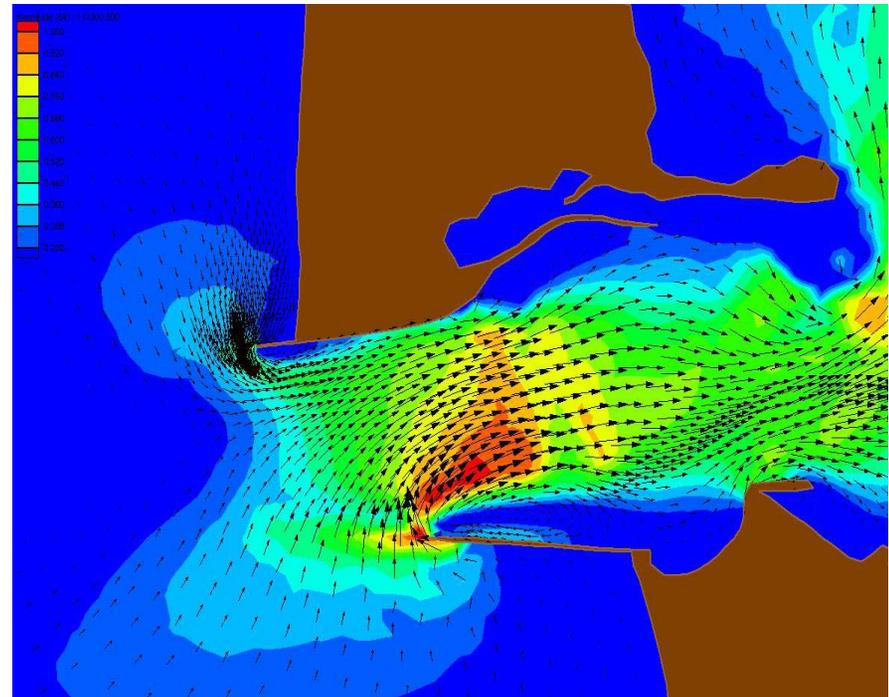
Peak Flood



Case Study Summary



- More Steering Module features on the way
- STWAVE → ADCIRC:
 - Higher velocities near mouth of inlet
- ADCIRC → STWAVE
 - Ebb: increase in wave height
 - Flood: flattening of waves



Steering vs. Standard Methods



- Conventional Method
 - Repetitive manual data interpolation
 - User monitors model runs
 - Time intensive
 - Too labor intensive to be practical
- Steering Module
 - Automated data interpolation
 - Model runs monitored by SMS
 - Reduces overall time to run models
 - Less user error produces more accurate results

